

# Penetrating Neck Wounds

## Mandatory Versus Selective Exploration

ADOLFO M. AYUYAO, M.D., F.A.C.S.,\* YAO L. KALEDZI, M.D.,† MOHAMAD H. PARSA, M.D., F.A.C.S.,‡  
HAROLD P. FREEMAN, M.D., F.A.C.S.§

We reviewed the records of 257 patients (ages, 16–83 years) with penetrating neck wounds (119 gunshot and 138 stab) managed at Harlem Hospital Center. Among the first 148 patients, 134 were managed by mandatory neck exploration; 42 had injuries (31%), and 92 (69%) had no injury. There were four deaths (3%) and seven (5%) morbidities. Because of the high rate of unnecessary operations, the following 109 patients were managed selectively, 40 by exploration, and nine of the 40 (22%) had no injury; 69 were observed and did not require subsequent operative intervention. There were six deaths (5.5%) and six morbidities (5.5%) among the second group. Morbidity and mortality were unrelated to the method of management but related to the type and severity of injuries, associated injuries, preexisting illnesses, and age of the patients. The frequency of operations for penetrating neck wounds without structural injuries was minimized in the selective exploration group.

**M**ANAGEMENT OF penetrating neck wounds by mandatory or selective exploration remains controversial. Advocates of mandatory neck exploration maintain that the “incidence of innocuous-looking wounds harboring serious injuries” is so high that all neck wounds that penetrate the platysma should be managed by exploration.<sup>1–5</sup> The low morbidity rate and the short duration of hospital stay following exploration revealing no injury has also been cited in favor of mandatory neck exploration.

Advocates of selective neck exploration cite the high unnecessary operation rate consequent to mandatory neck

*From the Department of Surgery, Harlem Hospital Center, Columbia University, College of Physicians and Surgeons, New York, New York*

exploration against this method of management. The low cost effectiveness of mandatory neck exploration and increased occupation of surgical beds and operating rooms have also been mentioned in favor of selective exploration.<sup>6–14</sup>

We present a retrospective study comparing two consecutive groups of patients with penetrating neck wounds managed by mandatory and selective neck explorations.

### Materials and Methods

Records of all patients with penetrating wounds to the neck (injuries that penetrated the platysma) were reviewed and analyzed. Initial management in these patients consisted of ensuring patent airway, effective breathing, control of bleeding by applying direct pressure using a packing and/or finger pressure (Figs. 1 and 2), treatment of shock, and a thorough search for other injuries. Chest and neck x-ray films were obtained in all patients who were in stable condition. Patients with clinical evidences suggestive of a serious injury were subjected to neck exploration. Angiography, esophagography, bronchoscopy, and esophagoscopy were employed when indicated.

Group I includes patients managed from January 1975 to June 1981 by mandatory neck exploration. During this period, all but 14 patients admitted with penetrating neck wounds, regardless of the presence or absence of clinical manifestations indicating serious injuries to the neck, underwent neck exploration.

Group II includes patients managed from July 1981 to September 1984 by selective neck exploration. Patients without clinical evidence of a serious injury were observed. When indicated, angiography, esophagography, bronchoscopy, and esophagoscopy were performed. Patients

\* Associate Director, Trauma Center, Harlem Hospital Center.

† Chief Resident in Surgery, Harlem Hospital Center.

‡ Director, Trauma Center, Harlem Hospital Center; Associate Clinical Professor of Surgery, Columbia University, College of Physicians and Surgeons.

§ Director of Surgery, Harlem Hospital Center; Associate Clinical Professor of Surgery, Columbia University, College of Physicians and Surgeons.

Presented to the New York Surgical Society Meeting, December 12, 1984.

Reprint requests: M. H. Parsa, M.D., Department of Surgery, Harlem Hospital Center, New York, NY 10037.

Submitted for publication: January 15, 1985.

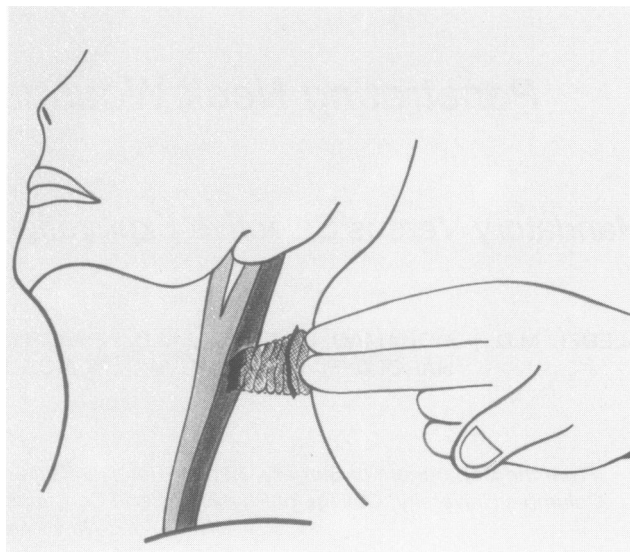


FIG. 1. Hemostasis in bleeding wounds with straight tract can be achieved by packing and adequate pressure applied over the packing by a hand or by pressure taping.

with signs and symptoms indicating injury to the vital structures of the neck were explored in due time.

Our indications for neck exploration are: Hypotension or shock resulting from neck injury; profuse external bleeding; large or expanding hematoma; difficulty in

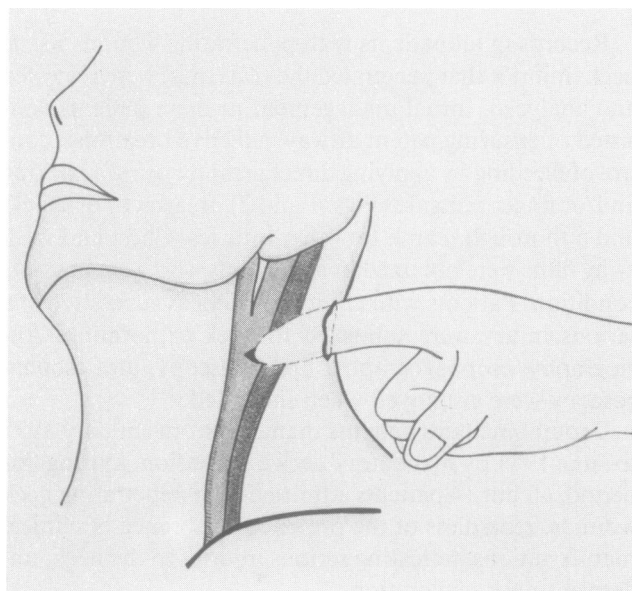


FIG. 2. Hemostasis in the wounds with zigzag tract can best be achieved by introduction of an index finger of a hand covered by sterile glove applying pressure to the bleeding site. The person who is applying finger pressure goes to the operating room with the patient until finger compression is replaced by someone in the operating field. Small skin wounds that do not admit a finger should be enlarged.

TABLE 1. *Summary of Experience*

	Group I*	Group II†	Total
Number of patients	148	109	257
Stab wounds	73	65	138
Gunshot wounds	75	44	119
Explored:	134	40	174
Injuries present	42	31	73
No injury	92	9	101
Observed	14	69	83
Morbidity	7	6	13
Mortality	4	6	10

\* Mandatory neck exploration.

† Selective neck exploration.

swallowing; neurological deficits or coma resulting from neck injury; diminished or absent carotid pulse, especially in the young; subcutaneous emphysema; coughing, spitting, or vomiting blood; and respiratory distress resulting from neck injury.

## Results

During the 9-year period studied, 257 patients with penetrating neck injury were managed. One hundred thirty-eight (54%) had stab injuries, and 119 (46%) had gunshot injuries (Table 1). One hundred seventy-four patients were managed by neck exploration, and 83 were observed. Among those explored, 73 had structural injuries (injury to a named structure of the neck, except muscles), and 101 had no structural injury. There were 10 deaths and 13 morbidities in the entire series.

## Comparison of the Two Groups

One hundred forty-eight patients were managed during the period of mandatory exploration. Seventy-three (49%) had stab injuries and 75 (51%) had gunshot wounds. There were 140 males and eight females; the age ranged from 16 to 83, with an average of 33 years. The initial clinical findings indicating serious injuries in this group are shown in Table 2 and compared to those of the selective neck exploration group. Sixty-eight patients had one or more of these findings, and 80 had no clinical evidence of a serious injury.

One hundred thirty-four patients in this group were explored, while 14 did not have operative treatment for a variety of reasons. Among those explored, 42 (31%) had structural injuries and 92 (69%) did not have any structural injury at exploration. Injuries found at operation are listed in Table 3 and compared to those found in the selective exploration group. Vascular injuries were the most common operative findings, with venous injuries occurring more frequently than arterial injuries. There were seven (5%) complications in this group (Table 4),

TABLE 2. Comparison in Both Groups of Frequency of Clinical Findings Indicating Serious Injuries

Clinical Manifestations	Group I Mandatory	Group II Selective	Total
Hypotension, shock	21	11	32
Profuse external bleeding	20	8	28
Large or expanding hematoma	13	8	21
Subcutaneous emphysema	9	2	11
Neurological deficits	7	8	15
Dysphagia	6	2	8
Absent or decreased carotid pulse	5	4	9
Hemoptysis, hematemesis, bloody spit	4	0	4
Cardiorespiratory arrest	4	2	6
Hoarseness	2	0	2
Respiratory distress	0	2	2

and all occurred in patients who were explored. Four (3%) patients died as a result of their neck injuries, and all were among the explored cases. Deaths in both groups are listed in Table 5. Three of the four deaths in this group with major vascular injuries had exsanguinated when seen initially. Two of the three had cardiac arrests requiring emergency room thoracotomy for direct cardiac compression. One patient had profuse oral bleeding and developed cardiac arrest during a difficult endotracheal intubation and died 3 days later. The fourth patient had severe bowel and liver injuries, in addition to subclavian and innominate vein lacerations. He died of severe respiratory failure 3 days after the operation.

One hundred nine patients were managed by selective neck exploration. Sixty-five (60%) had stab wounds, and 44 (40%) had gunshot wounds. There were 100 males and nine females. Of the 109 patients, 40 (37%) were managed by neck exploration, and 69 (63%) were observed. Among the explored cases, 31 (78%) had injuries, and nine (22%) did not have any injury at exploration (Table 1). The initial clinical findings indicating a serious injury in this group are also listed in Table 2 and compared to those in the mandatory exploration group. Thirty-three of these patients had one or more of these findings, and 76 did not show any clinical evidence of serious injuries. The injuries found at operation in Group II are listed in Table 3 and compared to those in Group I. Again, vascular injuries were the most common, with venous injuries outnumbering arterial injuries. In this group of patients, there were six (5.5%) morbidities and six (5.5%) deaths (Tables 4 and 5). Four of the deaths in this group were among the operative cases, and two were among the patients managed without surgery. One of the two patients was a 62-year-old debilitated male with chronic obstructive pulmonary disease admitted with congestive heart failure

TABLE 3. Operative Findings Compared in Both Groups

Injury	Group I Mandatory	Group II Selective	Total
Vascular:	(37)	(33)	(70)
External jugular vein	12	8	20
Internal jugular vein	8	9	17
Subclavian vein	4	3	7
Common carotid artery	2	6	8
Subclavian artery	2	1	3
Facial artery	2	0	2
Lingual artery	2	1	3
External carotid artery	1	1	2
Superior thyroid artery	1	1	2
Occipital artery	1	1	2
Facial vein	1	0	1
Brachiocephalic vein	1	2	3
Thoracic duct	(1)	(1)	(2)
Digestive:	(5)	(9)	(14)
Pharynx	2	2	4
Esophagus	1	1	2
Parotid gland	1	4	5
Submandibular gland	1	2	3
Respiratory:	(5)	(6)	(11)
Larynx	4	3	7
Trachea	1	2	3
Thyroid cartilage	0	1	1
Neurological:	(2)	(2)	(4)
Spinal cord	2	2	4

( ) = total.

and had a history of a recent myocardial infarction. He had a small stab wound in the midline of the neck with a small subcutaneous emphysema around the wound. He also had a stab wound in the right chest with a small

TABLE 4. Complications

Morbidities	Number	Result
Group I: Mandatory Exploration		
Pharyngocutaneous fistula	2	Healed
Hemiparesis, hemiplegia	2	Unimproved
Facial nerve palsy	1	Improved
Dysphagia after laryngofissure	1	Resolved
Respiratory insufficiency	1	Resolved
Group II: Selective Exploration		
Esophagocutaneous fistula	1	Healed
Iatrogenic pneumothorax after neck exploration	1	Resolved
Wound infection and median sternotomy separation after neck exploration	1	Resolved
Right axillary arteriovenous fistula	1	Reoperated
Osteomyelitis, 2nd cervical vertebra—gunshot	1	Resolved
Postoperative bleeding after neck exploration, missing a subclavian vein injury	1	Reoperated

TABLE 5. *Mortalities*

Patient Number	Injuries	Management	Cause of Death
Group I: Mandatory Exploration			
1	Carotid artery	Site compression and thoracotomy*	Massive blood loss
2	Subclavian, innominate veins, bowel, and liver	Repair of lacerations	Respiratory failure
3	Pharynx and lingual artery	Tracheostomy repair of laceration and ligations	Cardiac arrest
4	Subclavian and vertebral arteries	Thoracotomy,* ligation, and repair of laceration	Anoxic brain damage
Group II: Selective Exploration			
5	Subclavian artery	Thoracotomy* repair of laceration	Massive blood loss
6	Tracheal puncture? Pneumothorax	Nonoperative	Myocardial infarction
7	Subclavian artery, trachea	Repair of lacerations	Massive blood loss
8	Cervical cord	Nonoperative	Cord transection
9	Carotid artery	Repair of laceration	Massive blood loss
10	Pharynx, parotid, thyroid cartilage	Repair of lacerations	Anoxic brain damage, septicemia

\* Emergency room thoracotomy for direct cardiac compression.

pneumothorax. We felt that operative management had a higher risk than nonoperative management. He died several days later from massive myocardial infarction. The second nonoperative death was a 21-year-old male who sustained a gunshot wound of the neck with transection of the cervical spinal cord. He was quadriplegic and in a coma on admission. He was maintained on life-supporting measures until he died 16 days later.

### Discussion

Fogelman in 1956<sup>15</sup> in a series of 100 cases of penetrating neck injuries reported a mortality rate of 11% and an association between death and delay in operation. Cordice and coworkers<sup>16</sup> in a series of 104 cases in 1966 emphasized the importance of control of hemorrhage by wound packing and/or finger compression for stabilization of the patient before operation. Asworth<sup>17</sup> in a series of 41 patients reported that a third of his patients with injury to a major structure had no clinical manifestation.

We find a high correlation between preoperative signs and symptoms and findings of injuries at neck exploration. On the other hand, among the 66 patients in Group I who had mandatory neck exploration without clinical signs and symptoms, 58 had no injury at exploration. Of the remaining eight patients who had some injuries as operative findings without any clinical signs and symptoms, none had a life-threatening injury.

Of the 69 patients in Group II who were observed, none required subsequent operative intervention. Therefore, the exploration rate of 69% in patients with no injuries who were treated by mandatory neck exploration is unreasonable. Among the 109 patients managed by selective neck exploration, four patients had neck exploration decided

on by the attending surgeons in the absence of clinical findings, and in all four no injury was found. If these four patients had been managed according to the selective neck exploration policy, our exploration rate with no injury would have been 14%.

We attempt to repair all major vascular injuries. Gortex® graft interposition was used once to repair a common carotid artery injury with loss of length. The external carotid artery was ligated in one patient. All other carotid artery injuries were managed by repair of partial lacerations or end-to-end anastomosis without shunting because of a good back flow of blood. Among the 257 patients, 78 had associated extracervical injuries. Twenty-six of the 78 patients had additional surgical procedures in areas other than the neck.

Of the 10 deaths in this series, seven patients were brought to the emergency room in profound hemorrhagic shock, unresponsive to verbal stimuli. Four of the 10 deaths occurred in the group treated by mandatory neck exploration, and the other six occurred in the group treated by selective neck exploration, a mortality rate of 4% for the entire series (2.7% and 5.5% in Groups I and II, respectively). The deaths reflect the severity of injury sustained, associated extracervical injuries, preexisting illness, and old age.

Recent literature<sup>1,18,19</sup> divides the neck into three zones and stresses the need for angiographic studies of all patients who are in stable condition with upper and lower neck injuries before operation. In this series, the trajectory of the wounding objects in many patients traversed two zones. Therefore, the location of the wound of entry is not a reliable indicator of the location of the injuries to the neck structures.

We employed angiographic studies in 51 consecutive patients with penetrating neck injuries who were either asymptomatic and/or in stable condition. Only two studies showed arterial injuries, both of which were suspected clinically. Therefore, we believe that angiography should be utilized for patients with clinical evidence or suspicion of arterial injuries who are in stable condition when angiographic findings may help the planning and preparation of the operative intervention. The existing venous injuries could not be demonstrated by late phase x-ray films of arteriography.

In patients with profuse bleeding from the pharynx and mouth, endotracheal intubation may be difficult. A patent airway in these patients may be secured more quickly and safely by an emergency tracheostomy or cricothyroidotomy.

### Conclusion

In a trauma center with experienced staff, frequency of operations for penetrating neck wounds without structural injuries can be minimized by selective neck exploration.

### Acknowledgment

The authors are grateful to Fernando Tabora, M.D., Fellow in Trauma and Critical Care, Harlem Hospital Center, who provided the illustrations for Figures 1 and 2.

### References

1. Saletta JD, Lowe RJ, Lim LT, et al. Penetrating trauma to the neck. *J Trauma* 1976; 16:579-587.
2. Elerding SC, Manart FD, Moore EE. A reappraisal of penetrating neck injury management. *J Trauma* 1980; 20:695-697.
3. Knightly JJ, Swaminathan AP, Rush BF. Management of penetrating wounds of the neck. *Am J Surg* 1973; 126:575-580.
4. Fitchett VH, Pomerantz M, Butsch DW, et al. Penetrating wounds of the neck. *Arch Surg* 1969; 99:307-314.
5. Jones RF, Terrell JC, Salyer KE. Penetrating wounds of the neck: an analysis of 274 cases. *J Trauma* 1967; 7:228-237.
6. Sheely CH, Mattox KL, Reul GJ Jr, et al. Current concepts in the management of penetrating neck trauma. *J Trauma* 1975; 15: 895-900.
7. May M, Lee C, Sapote P, et al. Penetrating wounds of the neck: selective exploration, a study of 100 cases. *Transactions of the American Academy of Ophthalmology* 1971; 75:496-509.
8. Williams JW, Sherman RT. Penetrating wounds of the neck, surgical management. *J Trauma* 1973; 13:435-442.
9. Flax RF, Fletcher HS, Joseph WL. Management of penetrating injuries of the neck. *Am Surg* 1973; 39:148-150.
10. Metzendorf MT, Lowe DK. Operation or observation for penetrating neck wounds? A retrospective analysis. *Am J Surg* 1984; 147: 646-652.
11. Narrod JA, Moore EE. Selective management of penetrating neck injuries. *Arch Surg* 1984; 119:574-582.
12. Belinkie SA, Russell JC, DaSilva J, Becker DR. Management of penetrating neck injuries. *J Trauma* 1983; 23:235-237.
13. Massac E Jr, Siram SM, Leffall LD Jr. Penetrating neck wounds. *Am J Surg* 1983; 145:263-265.
14. Rao PM, Bhatti MF, Gaudino J, et al. Penetrating injuries of the neck: criteria for exploration. *J Trauma* 1983; 23:47-49.
15. Fogelman MJ, Stewart RD. Penetrating wounds of the neck. *Am J Surg* 1956; 91:581-593.
16. Cordice JW Jr, Vaghei R. Direct wounds of the neck. *Medical Times* 1966; 94:961-971.
17. Ashworth C, Williams LF, Byrne JJ. Penetrating wounds of the neck: re-emphasis of the need for prompt exploration. *Am J Surg* 1971; 121:387-391.
18. Lundy J Jr, Mandal AK, Lou MA, Alexander JL. Experience in selective operations in the management of penetrating wounds of the neck. *Surg Gynecol Obstet* 1978; 147:845-848.
19. Roon AJ, Christensen N. Evaluation and treatment of penetrating cervical injuries. *J Trauma* 1979; 19:391-397.